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Int'l Filing Date 09 June 2004
Dkt No. 0666.2380000/TGD/AFK
Inventors: TAKAOKA, *et al.*
For: Charging Equipment for Secondary Battery

Fig. 1

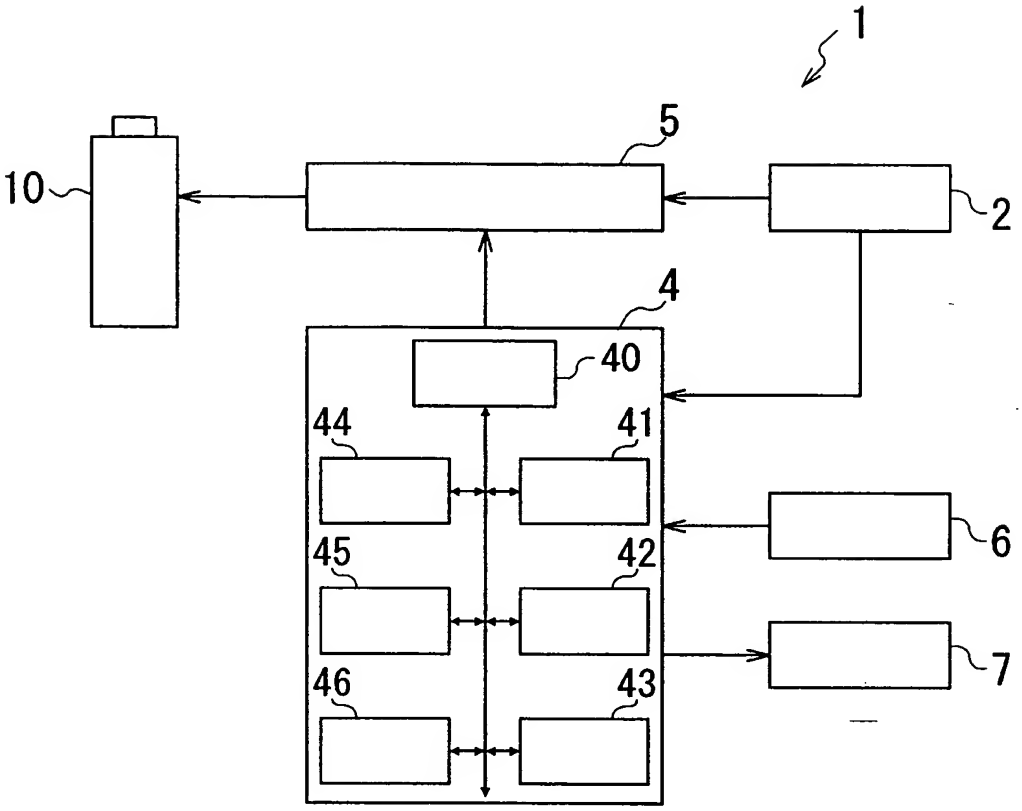

Fig. 2

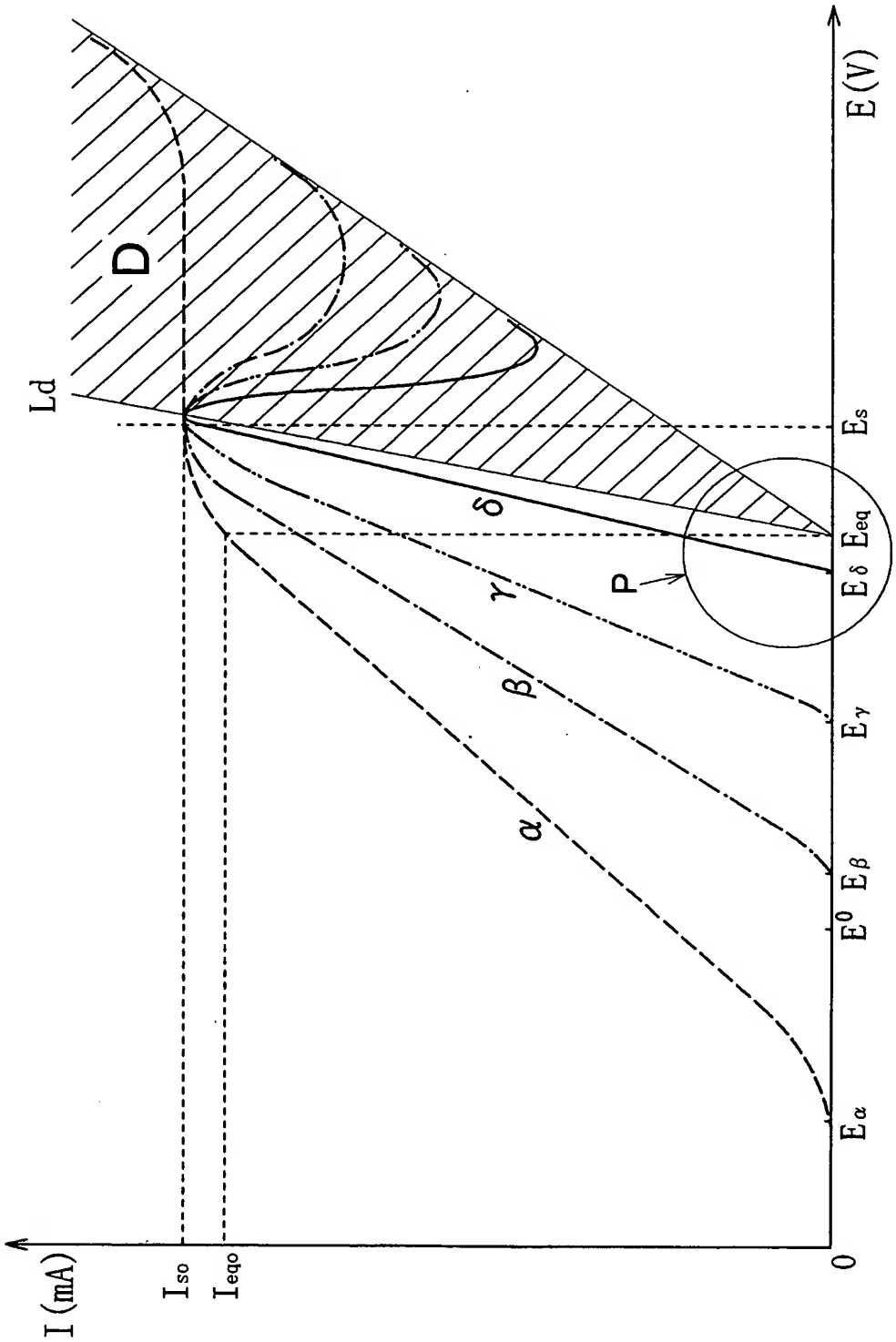

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Fig.3

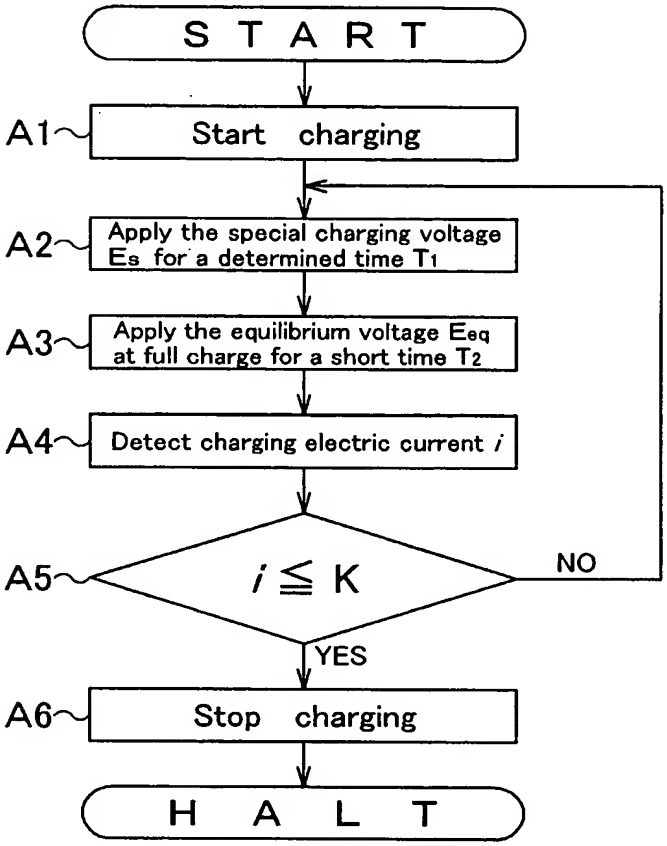

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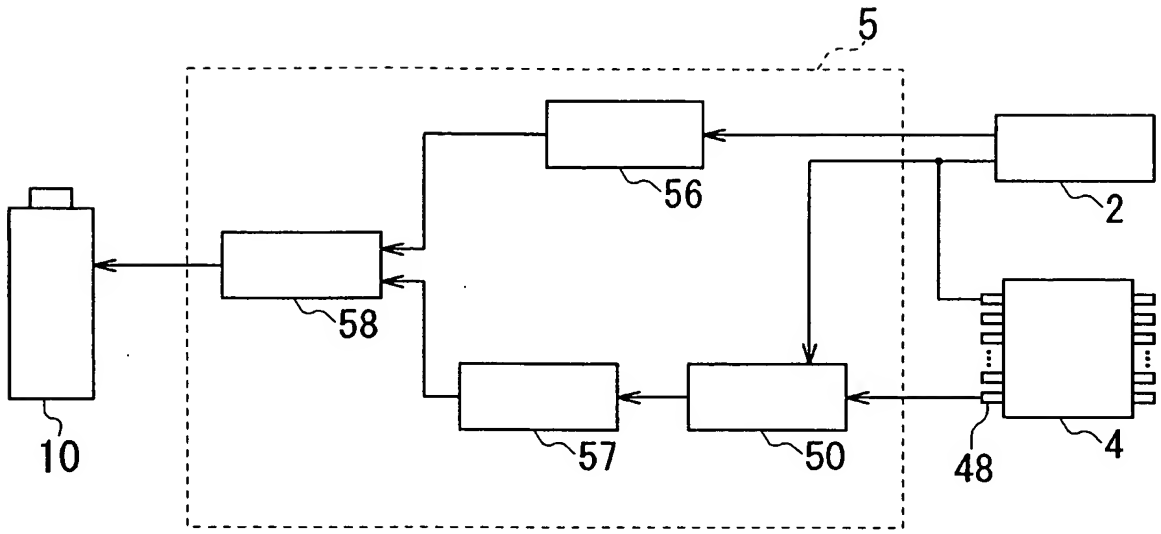
Fig. 4



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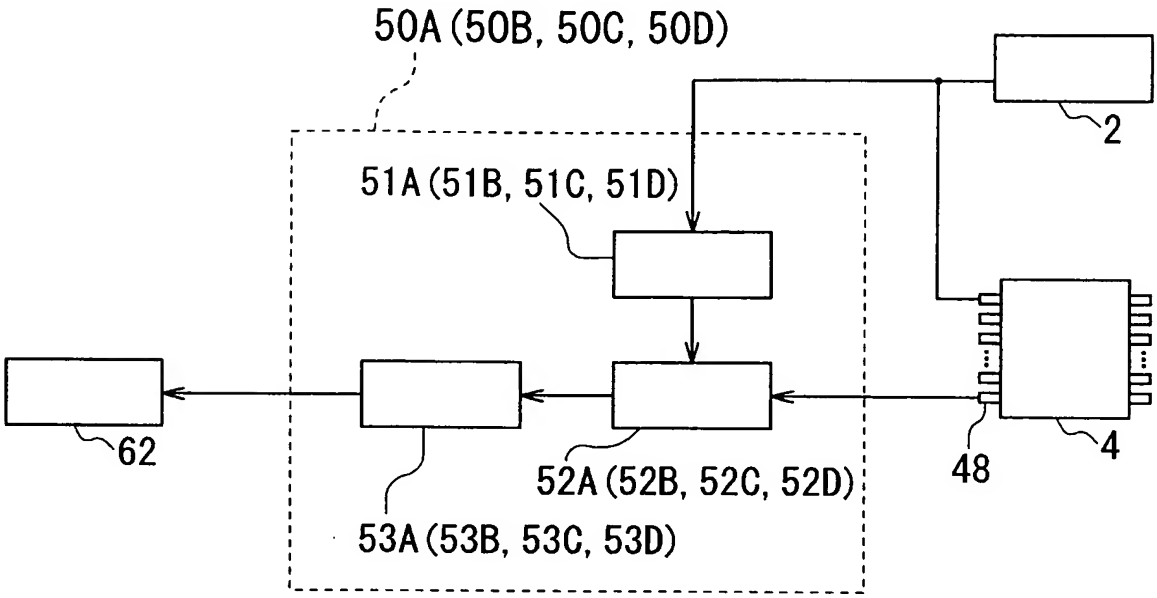

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Fig. 6

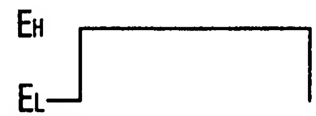
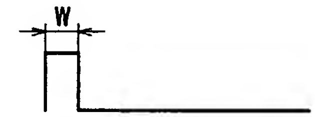
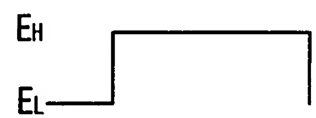
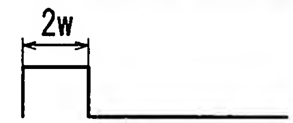
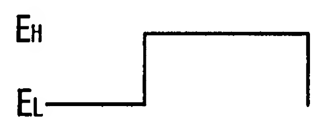
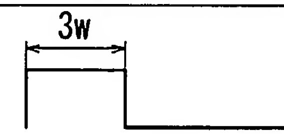
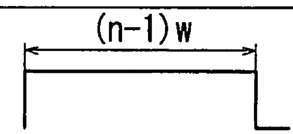
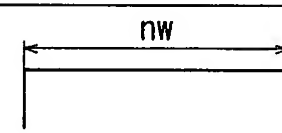
	a value of output from the arithmetic circuit 53A	a waveform outputted from the supremum and infimum voltage setting circuit 52A	a waveform outputted from the PWM output terminal 48
the 1st increment	$E_1 = E_L-(E_H-E_L)\cdot\frac{n-1}{n} = E_0+\Delta E$		
the 2nd increment	$E_2 = E_L-(E_H-E_L)\cdot\frac{n-2}{n} = E_0+2\cdot\Delta E$		
the 3rd increment	$E_3 = E_L-(E_H-E_L)\cdot\frac{n-3}{n} = E_0+3\cdot\Delta E$		
• • •	• • •	• • •	• • •
the (n-1)th increment	$E_{n-1}= E_L-(E_H-E_L)\cdot\frac{1}{n} = E_0+(n-1)\cdot\Delta E$		
the nth increment	$E_n = E_L = E_0+n\cdot\Delta E$		

Fig. 7

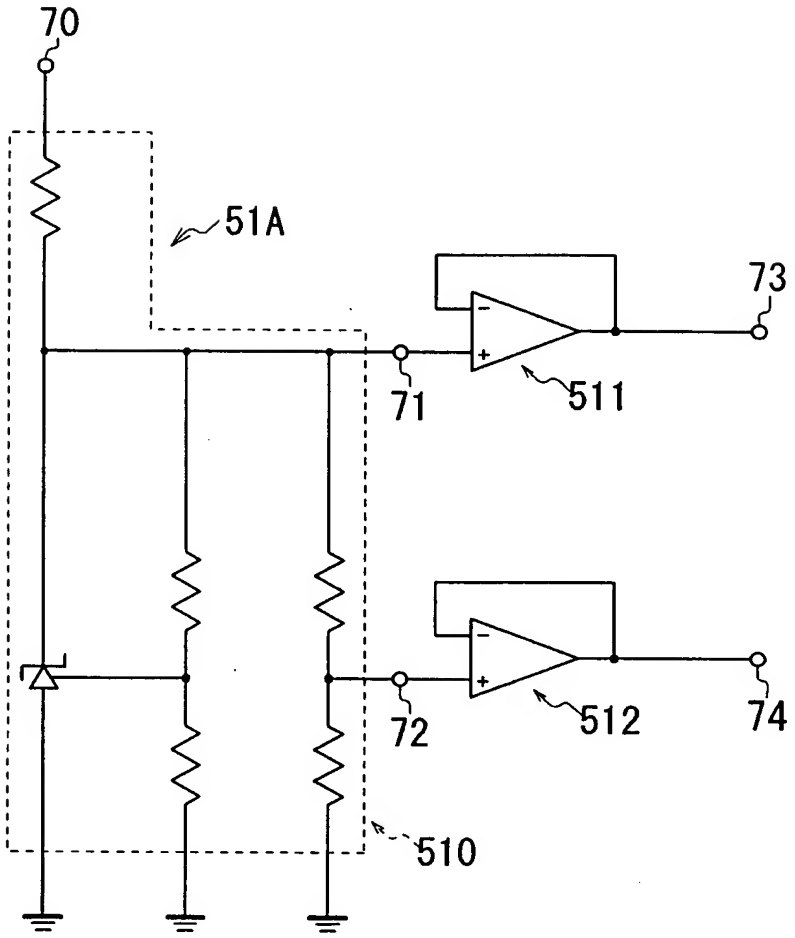


Fig. 8

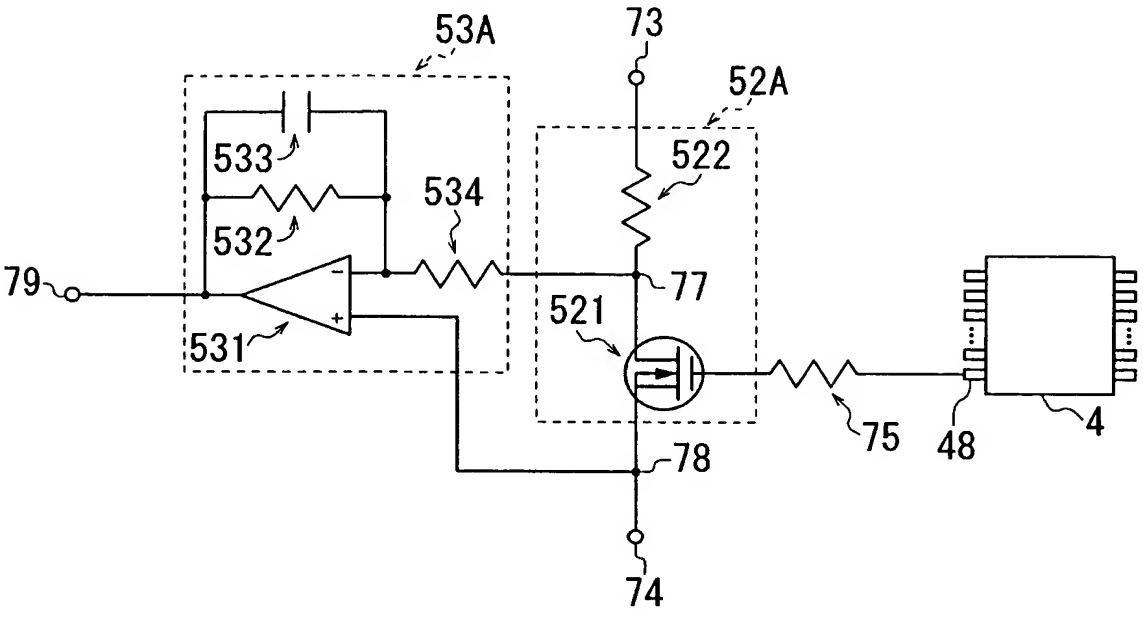


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Fig. 9

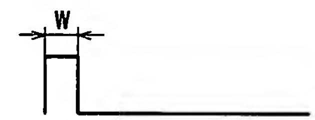
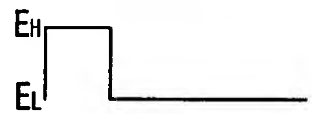
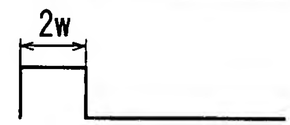
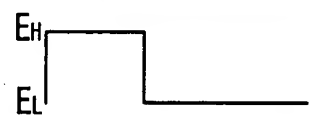
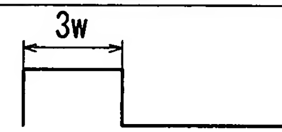
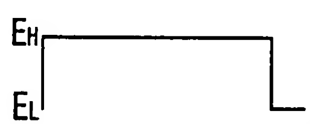
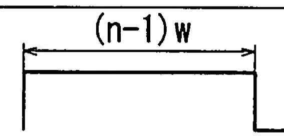
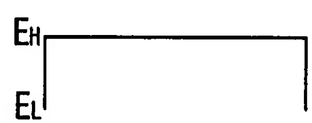
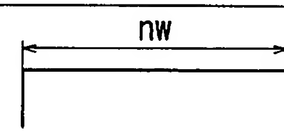
	a value of output from the arithmetic circuit 53B	a waveform outputted from the supremum and infimum voltage setting circuit 52B	a waveform outputted from the PWM output terminal 48
the 1st increment	$E_1 = E_L+(E_H-E_L)\cdot\frac{1}{n} = E_0+\Delta E$		
the 2nd increment	$E_2 = E_L+(E_H-E_L)\cdot\frac{2}{n} = E_0+2\cdot\Delta E$		
the 3rd increment	$E_3 = E_L+(E_H-E_L)\cdot\frac{3}{n} = E_0+3\cdot\Delta E$		
• • •	• • •	• • •	• • •
the (n-1)th increment	$E_{n-1}= E_L+(E_H-E_L)\cdot\frac{n-1}{n} = E_0+(n-1)\cdot\Delta E$		
the nth increment	$E_n = E_L+(E_H-E_L)\cdot\frac{n}{n} = E_0+n\cdot\Delta E$		

Fig. 1 0

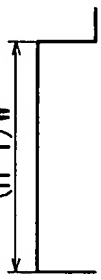
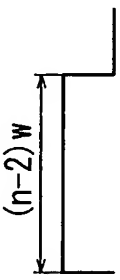
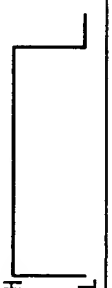
	a value of output from the arithmetic circuit 53C	a waveform outputted from the supremum and infimum voltage setting circuit 52C	a waveform outputted from the PWM output terminal 48
the 1st decrement	$E_1 = E_L + (E_H - E_L) \cdot \frac{1}{n} = E_0 + \Delta E$		
the 2nd decrement	$E_2 = E_L + (E_H - E_L) \cdot \frac{2}{n} = E_0 + 2 \cdot \Delta E$		
the 3rd decrement	$E_3 = E_L + (E_H - E_L) \cdot \frac{3}{n} = E_0 + 3 \cdot \Delta E$		
• • •	• • •	• • •	• • •
the (n-1)th decrement	$E_{n-1} = E_L + (E_H - E_L) \cdot \frac{n-1}{n} = E_0 + (n-1) \cdot \Delta E$		
the nth decrement	$E_n = E_L + (E_H - E_L) \cdot \frac{n}{n} = E_0 + n \cdot \Delta E$		

Fig. 1 1

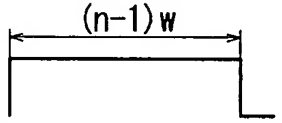
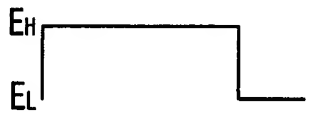
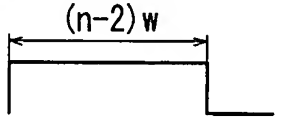
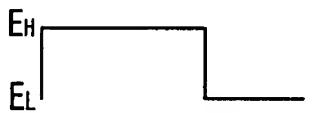
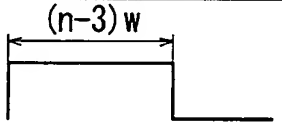
	a value of output from the arithmetic circuit 53C	a waveform outputted from the supremum and infimum voltage setting circuit 52C	a waveform outputted from the PWM output terminal 48
the 1st decrement	$E_1 = E_L-(E_H-E_L)\cdot\frac{n-1}{n} = E_0+\Delta E$		
the 2nd decrement	$E_2 = E_L-(E_H-E_L)\cdot\frac{n-2}{n} = E_0+2\cdot\Delta E$		
the 3rd decrement	$E_3 = E_L-(E_H-E_L)\cdot\frac{n-3}{n} = E_0+3\cdot\Delta E$		
• • •	• • •	• • •	• • •
the (n-1)th decrement	$E_{n-1}= E_L-(E_H-E_L)\cdot\frac{1}{n} = E_0+(n-1)\cdot\Delta E$		
the nth decrement	$E_n = E_L = E_0+n\cdot\Delta E$		

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Fig. 1 2

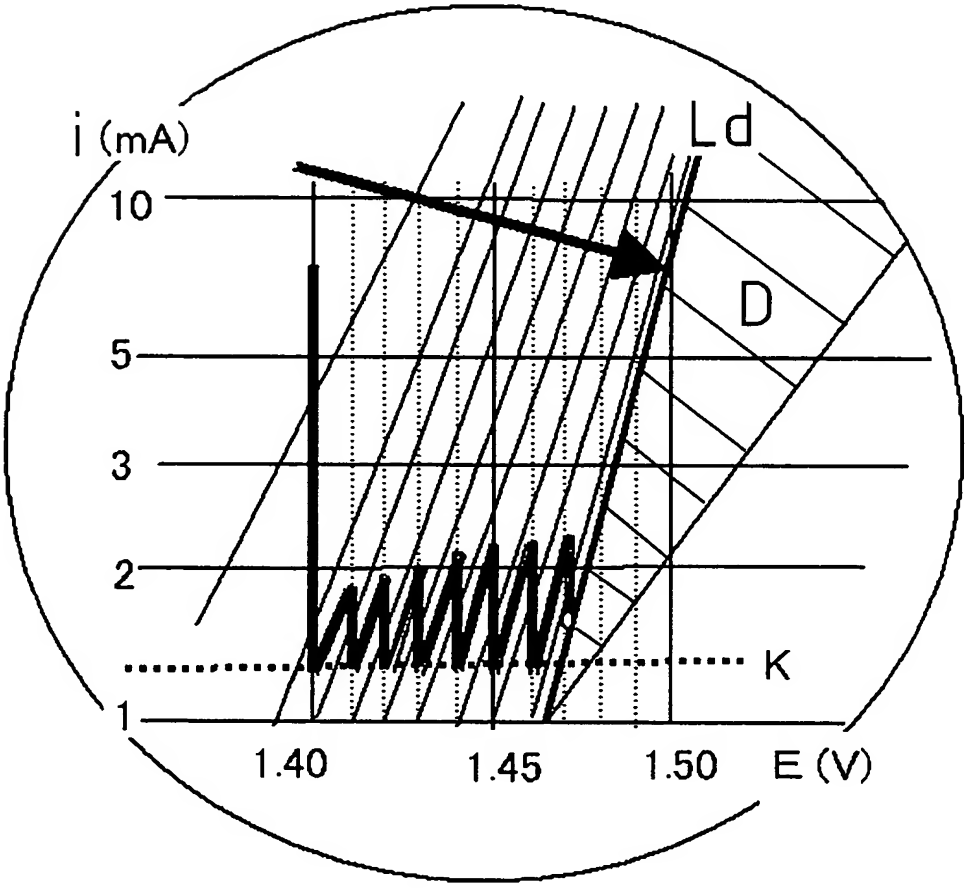

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Fig. 1 3

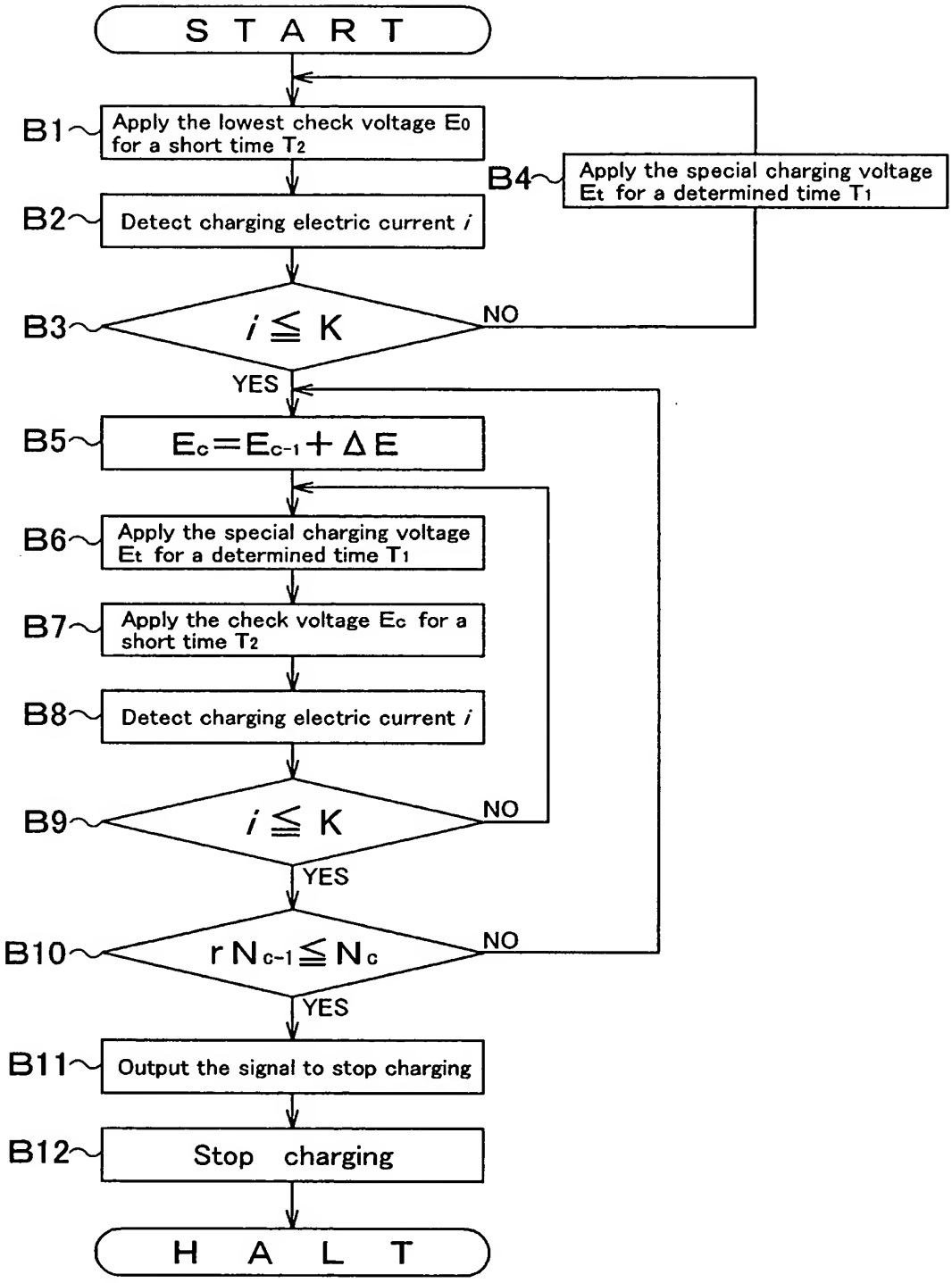

Fig. 1 4

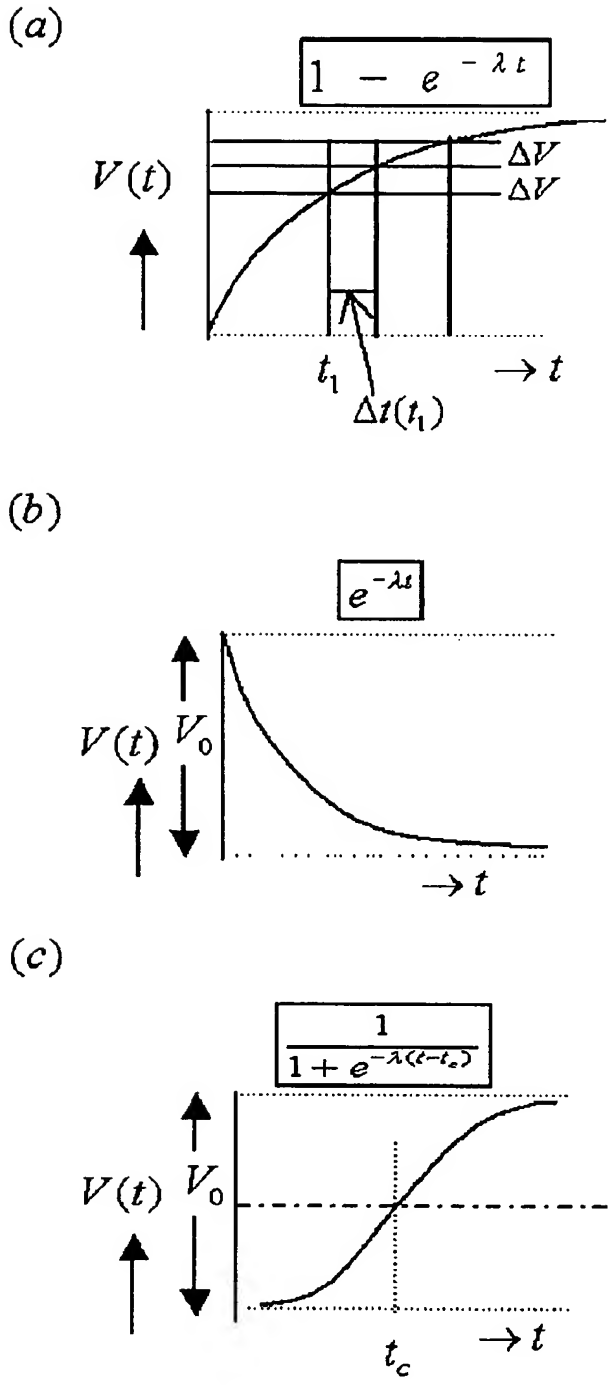
(a)
$1 - e^{-\lambda t}$
$V(t)$
ΔV
ΔV
t_1
$\Delta t(t_1)$
$\rightarrow t$
(b)
$e^{-\lambda t}$
$V(t)$
V_0
$\rightarrow t$
(c)
$\frac{1}{1+e^{-\lambda(t-t_c)}}$
$V(t)$
V_0
t_c
$\rightarrow t$

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Fig. 1 5

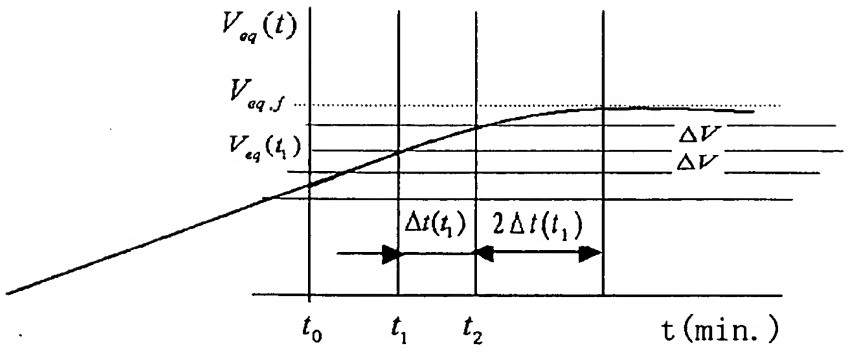

Fig. 1 6

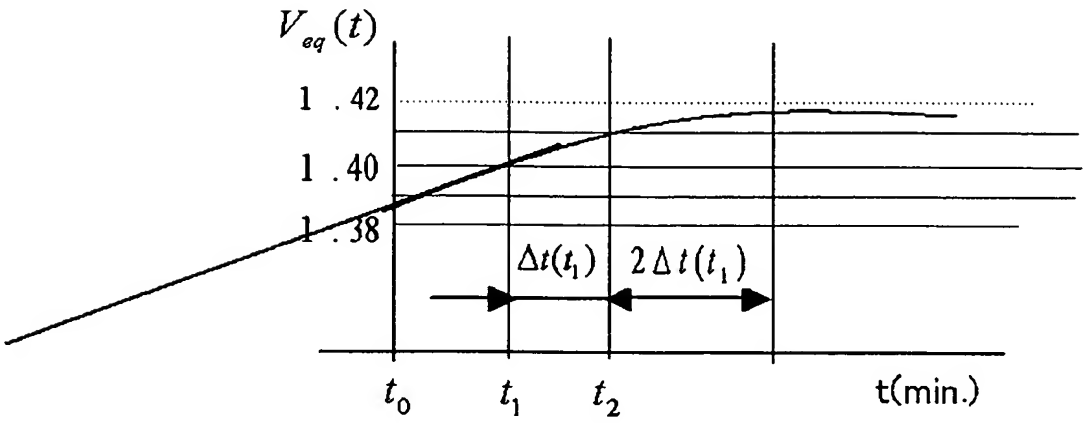

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Fig. 1 7

$V_{eq}(t_1)$	$\lambda \Delta t(t_1)$	A	$V_{eq}(t_2 + 2\Delta t(t_1))$	
1.39	↓ 0.463			
1.4	↓ 0.887	+		
1.41		−		
	↓ 2x0.887		1.4158	vs.1.42

Fig. 1 8

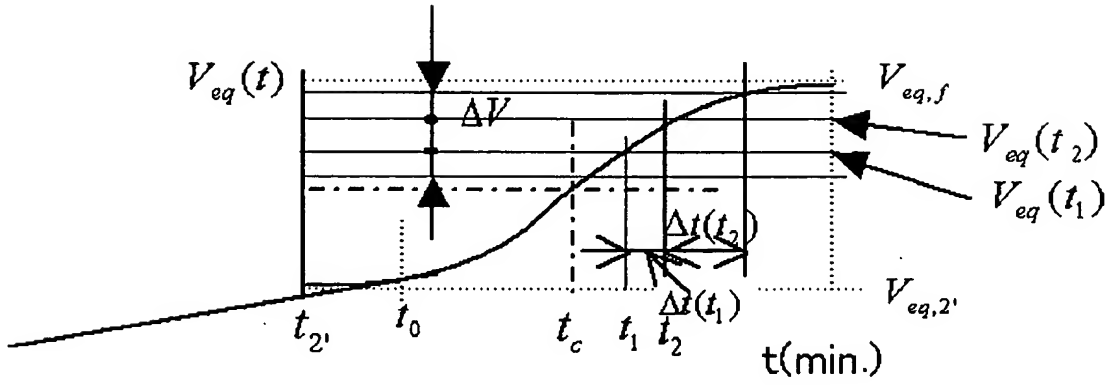
$V_{eq}(t)$
ΔV
$V_{eq,f}$
$V_{eq}(t_2)$
$V_{eq}(t_1)$
$\Delta t(t_2)$
$\Delta t(t_1)$
$V_{eq,2'}$
$t_{2'}$
t_0
t_c
t_1
t_2
t(min.)

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Fig. 1 9

	(1)V_{eqf}=1.455,V_{eq2}=1.395V		(2)V_{eqf}=1.445,V_{eq2}=1.395V		(3)V_{eqf}=1.435,V_{eq2}=1.395V	
V_{check}	$e^{-\lambda(t-tc)}$	$\lambda \Delta t(t)$	$e^{-\lambda(t-tc)}$	$\lambda \Delta t(t)$	$e^{-\lambda(t-tc)}$	$\lambda \Delta t(t)$
1.4	11	↓	9		7	
1.41	3	1.299	2.33	1.35	1.666	1.435
1.42	1.4	0.762	1	0.847	0.6	1.02
1.43	0.714	0.673	0.4286	0.847	0.1428	1.435
1.44	0.333	0.762	0.1111	1.35		1.435x2
1.45	0.0909	1.3		1.35x2		
		1.3x2				
final Veq	1.45459	99.97%	1.44463	99.97%	1.4347	99.97%